CLAIMS

1. A light guide for display devices of the head-mounted or head-up type, comprising:

- a body of the light guide at least in part transparent to visible light;

- a coupling device associated to the body of the light guide and designed to couple the body to an optical system designed to generate an image, the coupling device being obtained in such a way that the light beams coming from said optical system enter the body of the light guide and propagate in the body by total internal reflection; and

- an image-extraction grating designed to extract the light beams which propagate in the body of the light guide so as to enable an observer to visualize the extracted image on a background visible in transparency through the body of the light guide;

wherein

- said extraction grating is set in the proximity of one of the outer surfaces of the guide;

- said extraction grating has a saw-tooth profile;

- said extraction grating is coated with a partially reflecting coating deposited prevalently on the surfaces of the teeth that are least inclined with respect to the surfaces of the guide; and

- said coating is in turn coated with a layer of material having a refractive index that is substantially the same as that of the body of the light guide and having a surface facing the extraction grating, which follows the saw-tooth profile, and another plane surface which is substantially parallel to the outer surface of the guide in an area corresponding to which the grating is made.

2. The light guide according to Claim 1, comprising a beam-rotation grating, set between said coupling device and said image-extraction grating.

3. The light guide according to Claim 2, wherein:

- said rotation grating is set in the proximity of one of the outer surfaces of the guide;

- said rotation grating has a saw-tooth profile;

- said extraction grating is coated with a partially reflecting metal layer deposited prevalently on the surfaces of the teeth that are least inclined with respect to the surfaces of the guide; and

- said metal layer is coated with a layer of material having a refractive index that is substantially the same as that of the body of the light guide and having one surface, which follows the saw-tooth profile of the extraction grating, and another plane surface which is substantially parallel to the outer surface of the guide in an area corresponding to which the grating is made.

4. The light guide according to Claim 1, wherein said extraction grating is made so as to extract the light in multiple successive reflections, so as to extend the output pupil along the component of the direction of propagation of the beams that is parallel to the principal faces of the body of the light guide.

5. The light guide according to Claim 3, wherein the light is rotated in multiple successive reflections so as to extend the output pupil according to the component of the direction of propagation of the beams parallel to the plane faces of the body of the light guide.

6. The light guide according to Claim 3, wherein the light is rotated in multiple successive reflections and extracted in multiple successive reflections so as to extend the output pupil according to the component

of the direction of propagation of the beams that is parallel to the principal faces of the body of the light guide and in a direction orthogonal to said component.

7. The light guide according to Claim 1, wherein the coupling device is obtained such a way that the beams propagate in the body of the light guide in such a way that any section of the surface of the guide in the direction of propagation is touched by the beams.

8. The light guide according to Claim 1, wherein the reflectance of said grating is constant and comprised between 0.15 and 0.25.

9. The light guide according to Claim 1, wherein the reflectance of said grating is variable and ranges between 0.15 and 0.2.

10. The light guide according to Claim 1, wherein the reflectance of said grating is variable and ranges between 0.20 and 0.26.

11. The light guide according to Claim 3, wherein the reflectance of said beam-rotation grating is constant and comprised between 0.15 and 0.25.

12. The light guide according to Claim 3, wherein the reflectance of said beam-rotation grating is variable and ranges between 0.20 and 0.90.

13. The light guide according to Claim 3, wherein the reflectance of said beam-rotation grating is variable and ranges between 0.30 and 0.90.

14. The light guide according to Claim 3, wherein the reflectance of said beam-rotation grating is variable and ranges between 0.10 and 0.90.

15. The light guide according to Claim 3, wherein the surface of said saw-tooth profiles is coated with a material chosen in the group comprising chromium and aluminium.

16. The light guide according to Claim 1, wherein the image-extraction grating lies in a plane parallel to the principal faces of the body of the light guide having the greatest distance from the observer.

17. The light guide according to Claim 1, wherein the image-extraction grating lies in a plane inclined with respect to the principal faces of the body of the light guide and which radiuses two parallel plane faces of the body of the light guide.

18. The light guide according to Claim 1, wherein the body of the light guide is made of a material chosen in the group comprising glass, polycarbonate, and polymethylmethacrylate.

19. The light guide according to Claim 1, wherein the light propagates in the body of the light guide with a minimum angle of incidence of between 39° and 45° and a maximum angle of incidence of between 55° and 65°.

20. The light guide according to Claim 1, wherein the body of the light guide has a thickness of between 2 mm and 5 mm.

21. The light guide according to Claim 1, wherein said coupling device has a plane input surface.

22. The light guide according to Claim 1, wherein said coupling device has a curved input surface.

23. The light guide according to Claim 1, wherein said coupling device has an input surface consisting of a diffractive grating.

24. The light guide according to Claim 1, wherein said coupling device is a prism having an input surface parallel to a plane face of the body of the light guide, an output surface orthogonal to said plane face, and a totally or partially reflecting radiusing plane surface, which is inclined with respect to the input surface and the output surface.

25. The light guide according to Claim 1, wherein said coupling device is a prism having an input surface inclined with respect to a plane face of the body of the light guide, an output surface orthogonal to said plane face, and an opaque radiusing surface.

26. The light guide according to Claim 1, wherein the body of the light guide has at least one of its principal faces which is not plane.

27. The light guide according to Claim 1, wherein the body of the light guide is integrated in a lens for spectacles.

28. The light guide according to Claim 2, wherein the body of the light guide is integrated in a lens for spectacles.

29. The light guide according to Claim 1, wherein the body of the light guide is clipped on to a spectacle frame and is positioned within the field of view of the observer.

30. The light guide according to Claim 2, wherein the body of the light guide is clipped on to a spectacle frame and is positioned within the field of view of the observer.

31. The light guide according to Claim 1, wherein the display device has a field of view of 24°x18°.

32. The light guide according to Claim 2, wherein the display device has a field of view of 24°x18°.

33. The light guide according to Claim 1, wherein the display device has a field of view of 16°x12°.

34. The light guide according to Claim 2, wherein the display device has a field of view of 16°x12°.

35. A method for making a light guide according to Claim 1, comprising the following steps:

a) moulding of the guide with the saw-tooth gratings made on the surface, using one of the methods

belonging to the group: injection moulding, hot embossing, casting;

b) masking of the surfaces of the guide, except for the saw-tooth grating;

c) deposition of the metal layer with variable reflectance on the saw-tooth grating;

d) removal of mask;

e) insertion of the guide into a mould for casting;

f) deposition of the resin on the surface of the grating; and

g) polymerization of the resin;

where the steps from b) to g) are repeated for each saw-tooth grating present on the guide.

36. The method according to Claim 35, comprising a step of deposition of an antiscratch coating made by dipping.

37. The method according to Claim 35, wherein the deposition of the metal layer in step c) is performed by CVD, PVD, or sputtering.

38. The method according to Claim 35, wherein the deposition of the resin in step f) is performed by casting.

39. The method according to Claim 35, wherein the polymerization of the resin in step g) is performed by thermal or UV-radiation means.

40. The method according to Claim 35, wherein, prior to deposition of the metal layers, there is used a plasma treatment or chemical treatment for favouring adhesion thereof on the substrate.

41. The method according to Claim 35, wherein the variable reflectance of the coating is obtained with a relative movement of the guide with respect to a perforated mask set between the guide and the crucible containing the metal to be evaporated.

42. The method according to Claim 41, wherein the shape of the mask is determined by the profile of reflectance that it is intended to obtain.

43. The method according to Claim 35, wherein, after step f) and prior to step g), there is deposited on the resin a thin glass for guaranteeing planarity of the top surface of the coating.